

Updates to MSE evaluations

Superstanting States

HALIBUT COMMISS

RE

Agenda Item 4 IPHC-2023-MSAB018-06 **ESEARCH** (A. Hicks)

MSAB018

 <u>AM099–R</u> (para. 74): The Commission AGREED that a MSAB meeting should take place before the June SRB meeting in 2023 to discuss objectives, performance metrics, multi-year management procedures, dissemination of information to constituents, and methods for evaluation and presentation to the Commission. Noting budgetary constraints in FY2023, this meeting may be electronic.



Outline

- Review of AM099
- Priority objectives and performance metrics
- Additional simulations since MSAB018
- Examining long-term effects of the PDO
- Updating the OM



Completed for presentation at AM099

- Updated Operating Model (OM) in 2021
 - 4 models similar to assessment models
- Discussed objectives and performance metrics
- Evaluation of size limits
 - <u>AM099–Rec.03</u> (para. 84): The Commission **AGREED** sufficient analysis has been completed and **RECOMMENDED** not to change the current 32 inch size limit
- Evaluation of multi-year assessments
 - <u>AM099–R</u> (para. 85): The Commission **AGREED** that there is utility in continuing to explore multi-year stock assessment management procedures, in a manner consistent with the advice from SRB and MSAB



Other interesting outcome of AM099

- <u>AM099-R</u>, (para. 76): The Commission **RECOMMENDED** that for the purpose of a comprehensive and intelligible Harvest Strategy Policy (HSP), four coastwide objectives should be documented within the HSP, in priority order:
 - a) Maintain the long-term coastwide female spawning stock biomass above a biomass limit reference point (B20%) at least 95% of the time.
 - b) Maintain the long-term coastwide female spawning stock biomass at or above a biomass reference point (B36%) 50% or more of the time.
 - c) Optimise average coastwide TCEY.
 - d) Limit annual changes in the coastwide TCEY.



Other interesting outcome of AM099

- <u>AM099-R</u>, (para. 77): The Commission AGREED that the performance metrics associated with the objectives in Paragraph 76 are:
 - a) P(RSB< 20%) Probability that the long-term Relative Spawning Biomass (RSB) is less than the Relative Spawning Biomass Limit, failing if the value is greater than 0.05.
 - b) P(RSB<36%): Probability that the long-term RSB is less than the Relative Spawning Biomass Reference Point, failing if the value is greater than 0.50.
 - c) Median TCEY: the median of the short-term average TCEY over a ten-year period, where the shortterm is 4-14 years in the future.
 - d) Median AAV TCEY: the average annual variability of the short-term TCEY determined as the average difference in the TCEY over a ten-year period.



Other interesting outcome of AM099

• <u>AM099-R</u>, (para. 78): The Commission **AGREED**

- that the HSP objectives should be used to rank management procedures which perform the best, while Regulatory Area-specific performance metrics should inform the deliberations of the MSAB and the Commission.
- For a management procedure to be a candidate for adoption by the Commission, the procedure must meet the first two HSP objectives (a and b in Paragraph 76), show relatively high median TCEYs, and within that subset, the relatively low median AAV for the TCEY.
- An adopted management procedure may be identified from the subset of management procedures that are consistent with the HSP and through finer spatial scale evaluation by the MSAB and Commission.
- <u>AM099-R</u>, (para. 78): The Commission **AGREED** that the MSE process should continue to examine the performance of management procedures at the coastwide, Biological Region and IPHC Regulatory Area level.



Priority Coastwide Objectives (order of importance)

GENERAL OBJECTIVE	MEASURABLE OBJECTIVE	MEASURABLE OUTCOME	TIME- FRAME	TOLER ANCE	Performance Metric
1.1. KEEP FEMALE SPAWNING BIOMASS ABOVE A LIMIT TO AVOID CRITICAL STOCK SIZES AND CONSERVE SPATIAL POPULATION STRUCTURE	Maintain a female spawning stock biomass above a biomass limit reference point at least 95% of the time	SB < Spawning Biomass Limit (SB _{Lim}) SB _{Lim} =20% unfished spawning biomass	Long- term	0.05	P(SB < SB _{Lim}) PASS/FAIL
2.1 MAINTAIN SPAWNING BIOMASS AT OR ABOVE A LEVEL THAT OPTIMIZES FISHING ACTIVITIES	Maintain the coastwide female spawning biomass at or above a biomass reference point at least 50% of the time	SB <spawning biomass<br="">Target (SB_{Targ}) SB_{Targ}=36% unfished spawning biomass</spawning>	Long- term	0.50	P(SB < SB _{Targ})
2.2. PROVIDE DIRECTED FISHING YIELD	Optimize average coastwide TCEY	Median coastwide TCEY	Short- term		Median TCEY
2.3. Limit Variability in Mortality Limits	Limit annual changes in the coastwide TCEY	Median coastwide Average Annual Variability (AAV)	Short- term		Median AAV
INTERNATIONAL PACIFIC					

Priority Coastwide Objectives (order of importance)

GENERAL OBJECTIVE	MEASURABLE OBJECTIVE	MEASURABLE OUTCOME	TIME- FRAME	TOLER ANCE	Performance Metric
1.1. KEEP FEMALE SPAWNING BIOMASS ABOVE A LIMIT TO AVOID CRITICAL STOCK SIZES AND CONSERVE SPATIAL POPULATION STRUCTURE	Maintain a female spawning stock biomass above a biomass limit reference point at least 95% of the time	SB < Spawning Biomass Limit (SB _{Lim}) SB _{Lim} =20% unfished spawning biomass	Long- term	0.05	P(SB < SB _{Lim}) Fail if greater than 0.05
2.1 MAINTAIN SPAWNING BIOMASS AT OR ABOVE A LEVEL THAT OPTIMIZES FISHING ACTIVITIES	Maintain the coastwide female spawning biomass at or above a biomass reference point at least 50% of the time	SB <spawning biomass<br="">Threshold (SB_{Thresh}) SB_{Thresh}=36% unfished spawning biomass</spawning>	Long- term	0.50	$P(SB < SB_{36\%})$ Fail if greater than 0.50
2.2. PROVIDE DIRECTED FISHING YIELD	Optimize average coastwide TCEY	Median coastwide TCEY	Short- term		Median <i>TCEY</i>
2.3. LIMIT VARIABILITY IN MORTALITY LIMITS	Limit annual changes in the coastwide TCEY	Median coastwide Average Annual Variability (AAV)	Short- term		Median AAV
INTERNATIONAL PACIFIC					

Additional Simulations

- Increased number of replicates for a small set of MPs from 500 presented at MSAB018 to 1,100 for AM099
- Reminders
 - Integrated over five (5) distribution procedures
 - Three options for non-assessment years
 - a) The same TCEY from the previous year for each IPHC Regulatory Area
 - b) Updating the coastwide TCEY proportionally to the change in the coastwide FISS O32 WPUE and updating the distribution of the TCEY using FISS results and the applied distribution procedure
 - c) Maintaining the same coastwide TCEY as the previous year but updating the distribution of the TCEY using FISS results and the applied distribution procedure



Multi-year: Coastwide objectives

MP name	MP-A32	MP-Ba32	MP-Bb32	MP-Bc32	MP-Tb32	(
Assessment Frequency	Annual Biennial T			Triennial	•	
Size Limit	32 inches					
Empirical Rule		a b c		b	٠	
SPR	0.43					-
						F
Biological Sustainability						
P(any RSB_y<20%)	PASS	PASS	PASS	PASS	PASS	-
Fishery Sustainability						
P(all RSB<36%)	0.180	0.164	0.164	0.168	0.197	•
Median average TCEY	58.3	57.8	58.5	57.7	58.3	
Median AAV TCEY	17.8%	13.2%	17.0%	13.2%	14.1%	

Increased replicates results in a more expected pattern in AAV



Constant TCEY

- Less on average (a & c)
- Smallest variability
- TCEY based on FISS is similar (b)
 - Slight decrease in variability with biennial,
 - Lowest variability with triennial

Effects of the PDO on MSE outcomes

- PDO is simulated as switching between high & low
- Conducted simulations with persistent high OR low PDO

Two questions

- 1. Is the IPHC interim harvest strategy robust to environmental regimes?
- 2. How do fishing and the environment affect the distribution of Pacific halibut spawning biomass?



Recruitment

- Average Recruitment linked to the Pacific Decadal Oscillation (PDO)
 - Defined as High or Low Regimes
- Distribution of recruits modelled with a link to PDO regimes





Movement

- Ontogenetic movement from Region 4 to Region 2
 - Rates differ for PDO regimes
- Movement within a Region





Changes in historical distribution





INTERNATIONAL PACIFIC HALIBUT COMMISSION

MSY Reference Points from MSE simulations From IPHC-2019-SRB015-11

Units of Biomass

Relative to regime unfished units



Dynamic reference points provide stable relative management quantities



INTERNATIONAL PACIFIC HALIBUT COMMISSION

Harvest Strategy: Status and yield





Performance metrics

MP name	MP-A32	MP-A32	MP-A32			
PDO	Both	Low	High			
SPR	0.43	0.43	0.43			
Replicates	1100	1100	1100			
Long-Term Metrics						
Median RSB	38.8%	38.3%	39.4%			
P(RSB_y<20%)	<0.001	<0.001	<0.001			
P(RSB<36%)	0.180	0.231	0.114			
Median TCEY	62.21	50.88	73.35			
P(any3 change TCEY > 15%)	0.852	0.844	0.832			
Median AAV TCEY	16.3%	16.9%	16.4%			
Short-term Metrics (4-13 yrs)						
Median TCEY	58.3	56.0	61.7			
P(any3 change TCEY > 15%)	0.906	0.895	0.896			
Median AAV TCEY	17.8%	17.6%	17.6%			



Spawning Biomass Distribution





Summary of examining PDO effects

- IPHC harvest strategy is responsive to changes in the distribution of Pacific halibut and is robust relative to conservation objectives
- Even though we cannot "manage" the PDO regime, it is useful to understand the effects of the PDO regime on the results, allowing for the separation of the effects of fishing from the effects of the environment
 - the environment sometimes may have a larger effect on the distribution of spawning biomass than fishing does (at an SPR of 43% using the five distribution procedures defined earlier)



Updating the Operating Model

- The 2022 stock assessment estimated a female natural mortality above 0.15 for 3 out of 4 of the assessment models
 - A new view of the overall productivity of the stock
- Past results used an OM based on the 2021 stock assessment
 - Two models assumed female natural mortality centered around 0.15
 - medAAF_lowM is no longer consistent with the assessment model



Potential changes to MSE outcomes

- The change to natural mortality is not likely to have a large effect on the MSE outcomes
 - Natural mortality simulated with variability
 - Comparison across MPs likely similar relative to each other
 - Reference SPR=43% supported for many reasons
 - E.g. Avoid trigger and reduce inter-annual variability







OM being updated for 2023

- Four models in the OM aligned with 2022 stock assessment
- Currently being conditioned



Recommendations

- 1) NOTE paper IPHC-2023-MSAB018-06 presenting simulations performed since MSAB017, priority objectives defined by the Commission, and potential outcomes after updating the operating model.
- 2) NOTE that additional replicates beyond those presented at MSAB017 resulted in more precise and slightly different values of the performance metrics, but the comparisons between management procedures remained the same.
- 3) NOTE that different PDO regimes (i.e. always high or always low)
 - a. had little effect on the priority conservation objective, but low PDO resulted in low TCEYs and high PDO resulted in high TCEYs;
 - b. affected the long-term distribution of spawning biomass differently in each Biological Region and;
 - c. may have as much or a larger effect on the long-term distribution of spawning biomass in each Biological Region than fishing with the current interim harvest strategy policy does.



INTERNATIONAL PACIFIC





INTERNATIONAL PACIFIC HALIBUT COMMISSION

